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Assessing chemical communication in the invasive crayfish Orconectes rusticus

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Assessing chemical communication in the invasive crayfish *Orconectes rusticus*

ELIZABETH LUSCAVAGE

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ELIZABETHTOWN COLLEGE

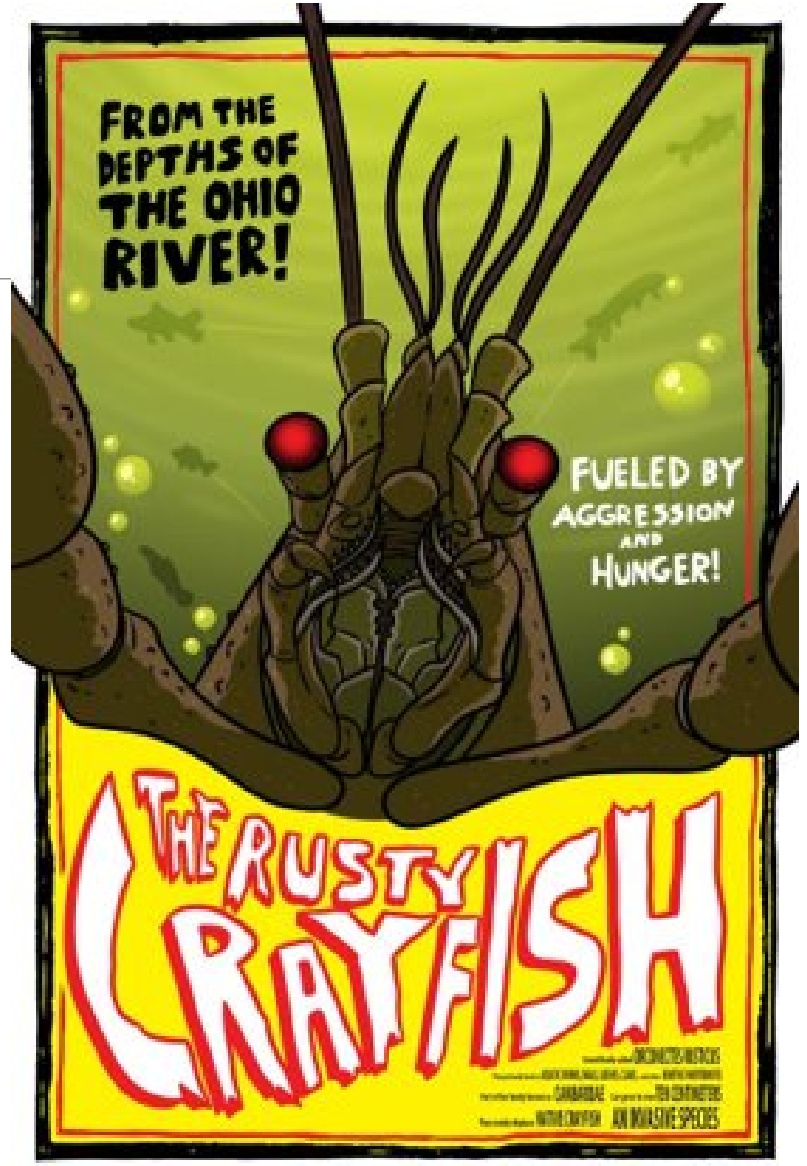
Invasive species harm native ecosystems

- Causes
  - Htchhiking
  - Ballast water
  - Pet trade

- Invasive species of PA
  - Brown marmorated stink bug
  - Japanese beetle

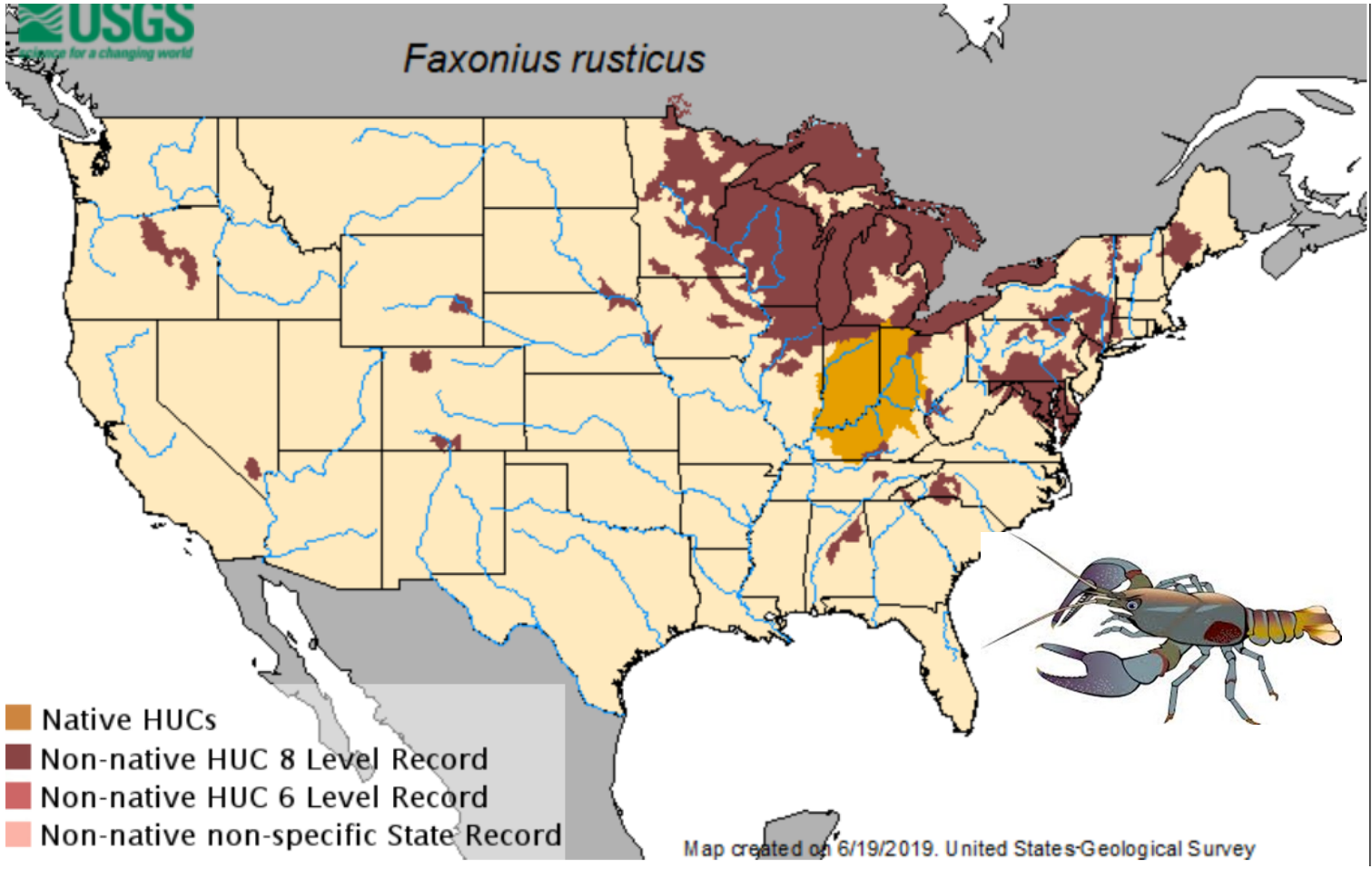
Crayfish in PA

- Invasive (Exotic)
  - *Orconectes rusticus*
  - *Orconectes virilis*
  - *Procambarus clarkii*



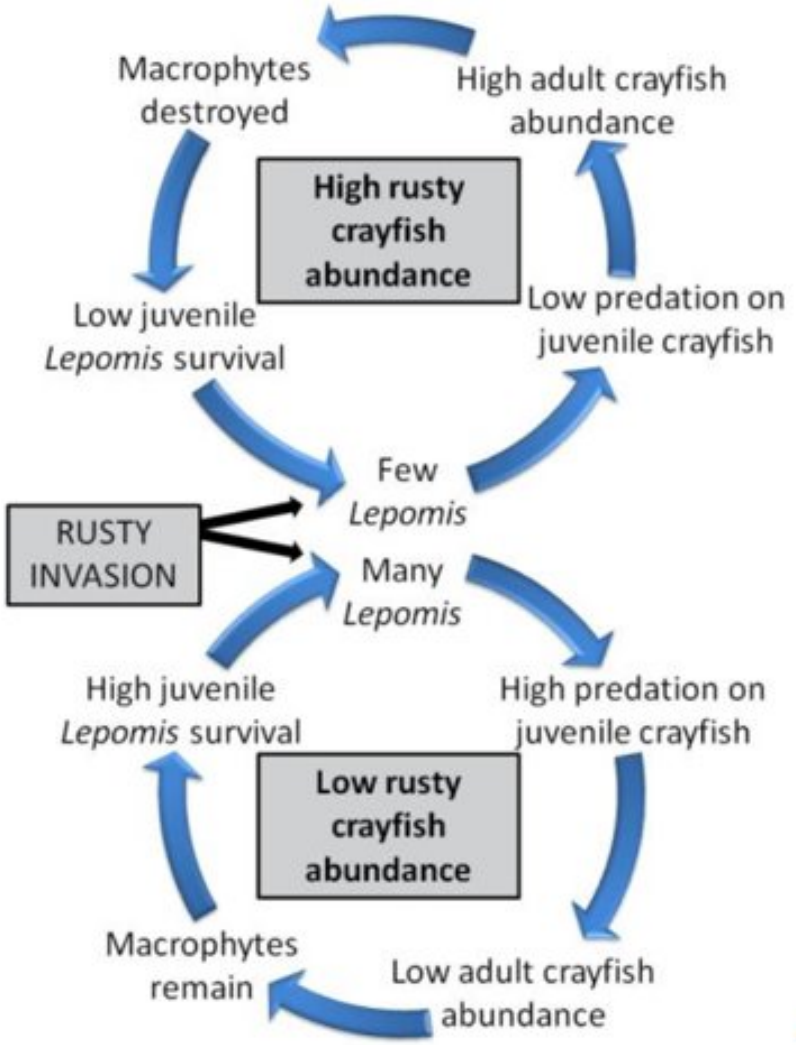
Orconectes rusticus

- Native to Ohio river valley
- First seen in PA in 1976
- Used as bait
- Traits
  - More aggressive
  - Larger body size
  - Hgher metabolic rate



Why you should care

- Displace native crayfish
  - *O. limosus*
  - *Cambarus (Puncticambarus) sp.*
  - *Cambarus bartonii*
- Overhunt native aquatic plants
  - Macrophyte beds
- Displace native aquatic animals
  - Snail species
  - *Fish species such as Lepomis (Sunfish)*



Roth et al., 2007

Rusty numbers are increasing across PA

Stream (drainage)	County	Nearby town	Lat, Long (decimal °)	Historical		Contemporary	
				Species	*n*	Species	*n*
Back Cr (P)	Franklin	Williamson	39.85422, −77.79622	*limosus*	NA	*virilis*	18
Conococheague Cr (P)	Franklin	Chambersburg	39.96102, −77.64832	*bartonii* *limosus*	NA NA	*bartonii* *obscurus* *virilis*	1 8 11
Conococheague Cr (P)	Franklin	Williamson	39.84675, −77.79425	*limosus*	NA	*bartonii* *obscurus* *virilis*	1 10 37
Bald Eagle Cr (S)	Centre	Milesburg	40.94309, −77.78700	*bartonii* *limosus*	NA NA	*obscurus*	25
Conoy Cr (S)	Lancaster	Bainbridge	40.08473, −76.66097	*bartonii*	20	*rusticus*	82
Conodoquinet Cr (S)	Cumberland	West Fairview	40.25543, −76.92745	*limosus*	NA	*rusticus*	22
Fishing Cr (S)	Columbia	Bloomsburg	40.99537, −76.47353	*limosus*	NA	*obscurus*	26
Montour Cr (S)	Perry	Green Park	40.35842, −77.31798	*bartonii* *limosus*	NA NA	*obscurus* *rusticus*	3 55
R Br Juniata R (S)	Bedford	Bedford	40.02013, −78.50278	*limosus*	NA	*obscurus*	7
Trib of Penns Cr (S)	Union/Snyder	New Berlin	Two possibilities[a]	*limosus*	1	*bartonii* *obscurus* *rusticus*	10[b] 17[b] 56[b]
Yellow Breeches Cr (S)	Cumberland/York	New Cumberland	40.22395, −76.86070	*limosus*	NA	*rusticus*	39

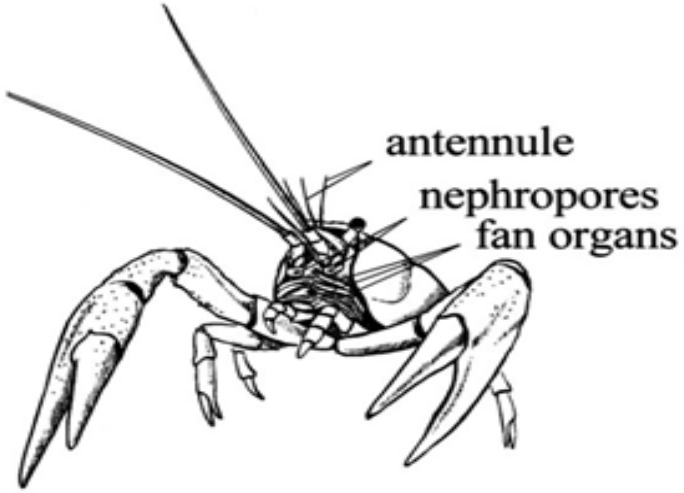
Lieb et al., 2011

Current trapping methods are not effective

- Pond drainages
- Individual capture
  - A female can lay between 50 to 400 eggs

Crayfish communicate chemically

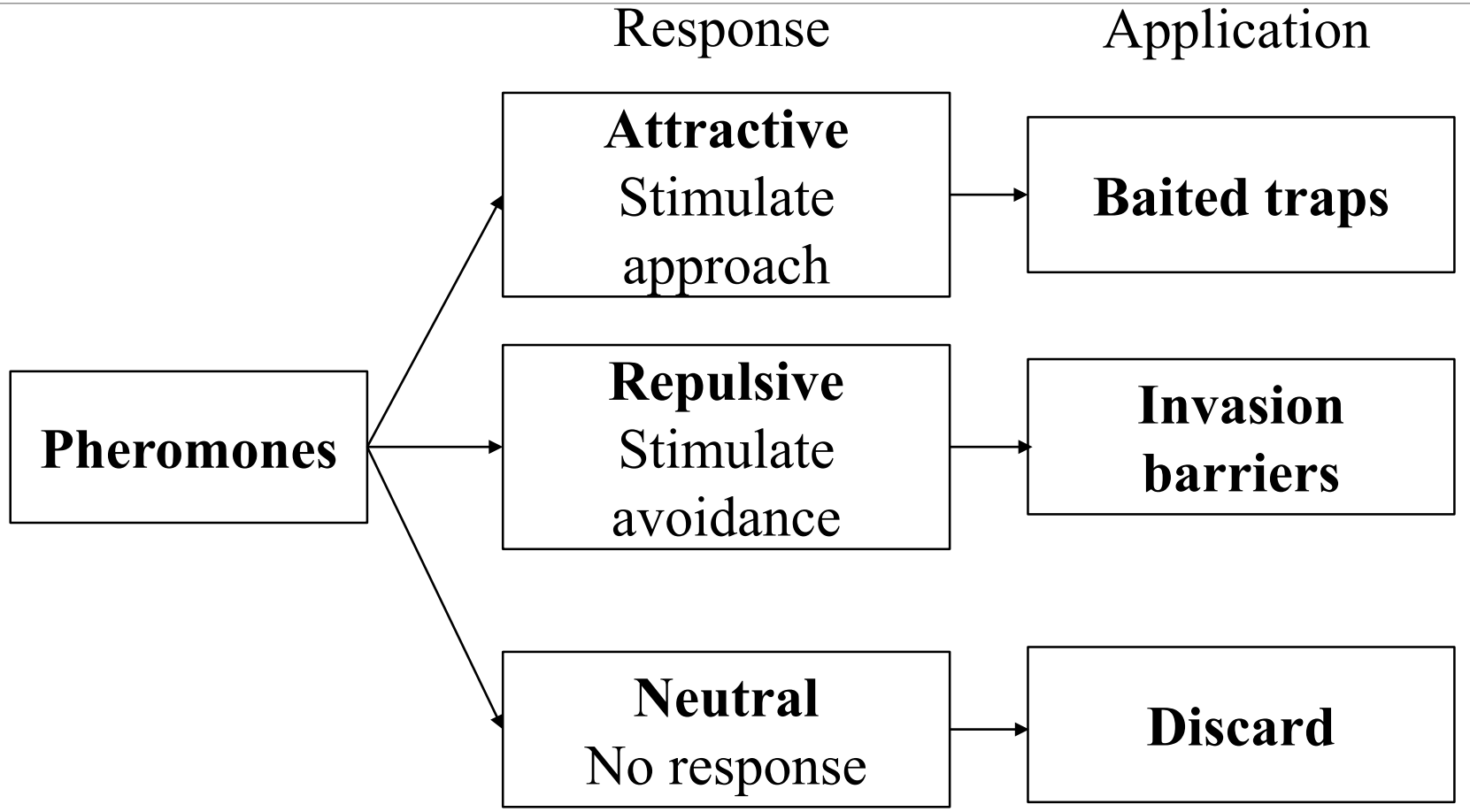
- Pheromones released in urine
- Conveys information about gender, species, and mates
- Chemoreceptors detect pheromones



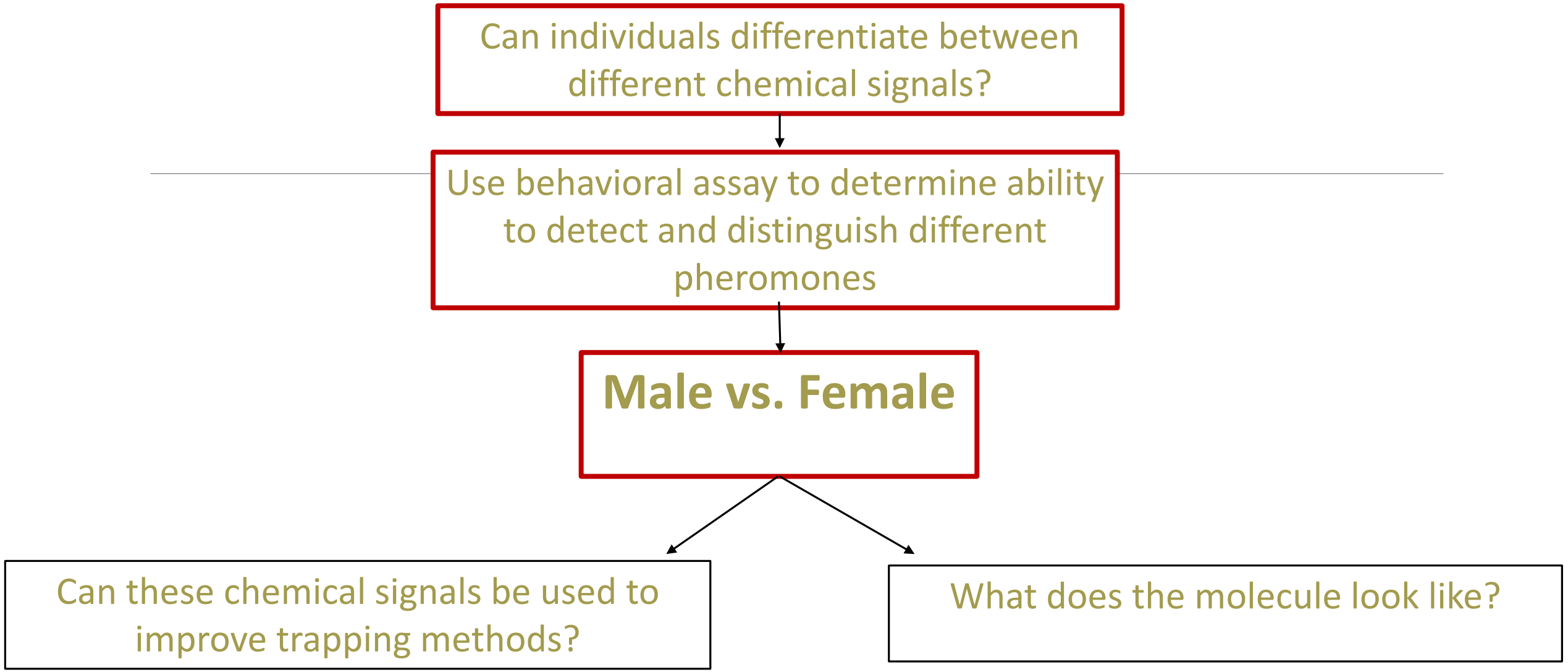
Pheromone traps a possibility?

- Previous success with insect pests
- Relatively species specific and environmentally safe
- Little success so far in aquatic species

Possible applications



Can *Orconectes rusticus* distinguish between pheromones?


Can individuals differentiate between different chemical signals?
Use behavioral assay to determine ability to detect and distinguish different pheromones
Male vs. Female
Can these chemical signals be used to improve trapping methods?
What does the molecule look like?

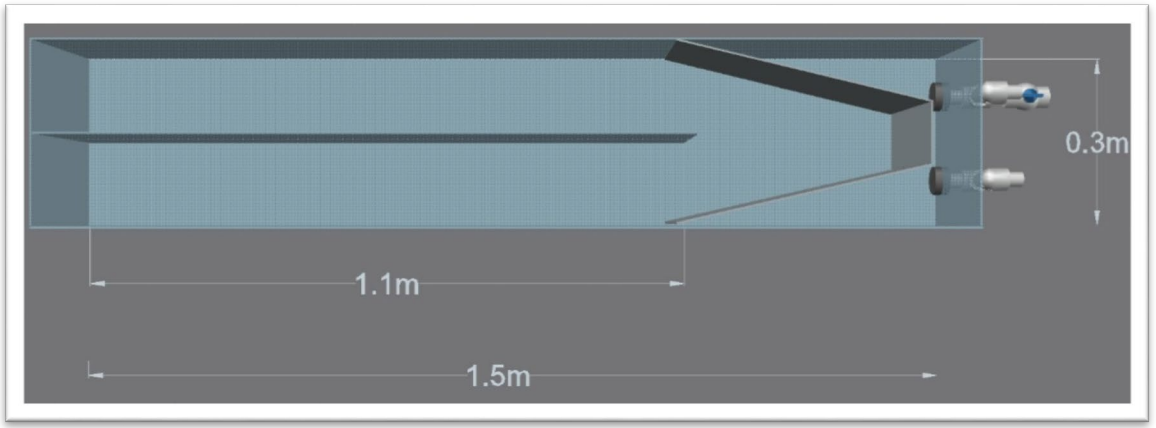
Previously found

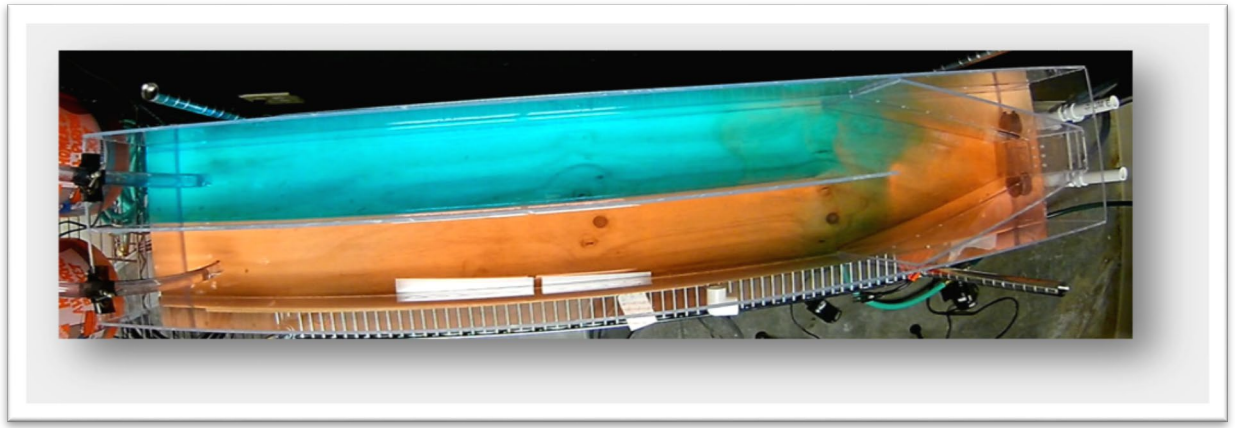
- When presented with a choice, Water vs. Pheromone:
  - Females were attracted to male and female pheromones
  - Males were repulsed by male pheromones, showed no preference for female pheromones

Kalmbacher and Goldina, 2017; Henry et al., 2016

Methodology

Y-maze validation





Water Level: 5.5 cm

Inflow Rate: 2.40 L/min per arm

Outflow rate: 2.45 L/min

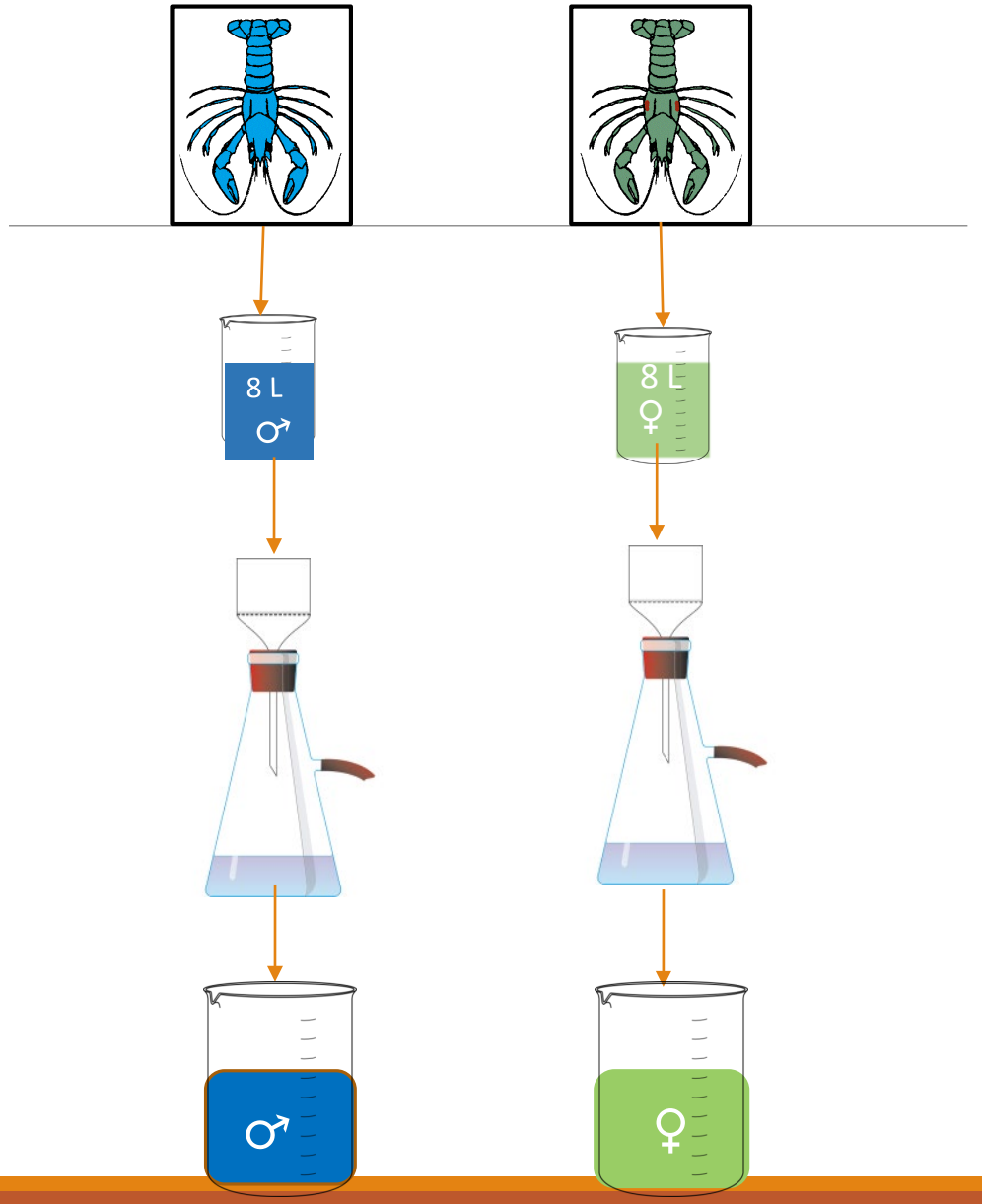
Pheromone stock collection

Social Isolation
7-9 days

Collect and filter water

Create stock

- **Combine water from 4 individuals**
  - **Dilute to 50% concentration**



Behavioral test

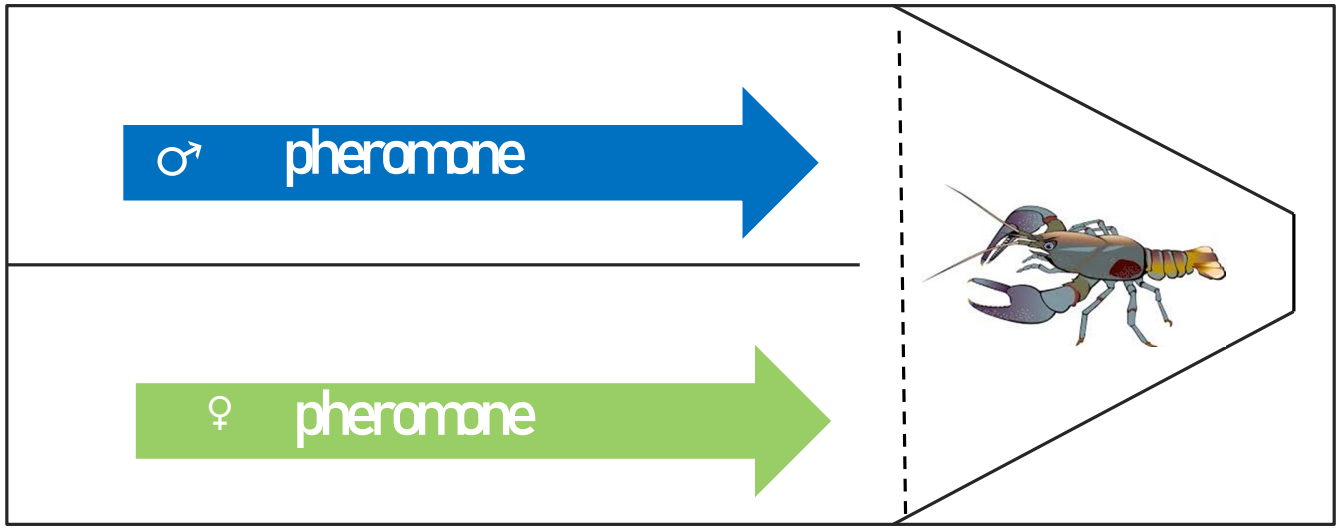
I. Isolation

7–9 days

II. Sample size

11 females

11 males



III. Behavioral assay

1. Acclimation in downstream compartment – 15 min
2. Turn on inflow pump for 3 min 33 sec.
3. Record individual movement patterns – 20 min

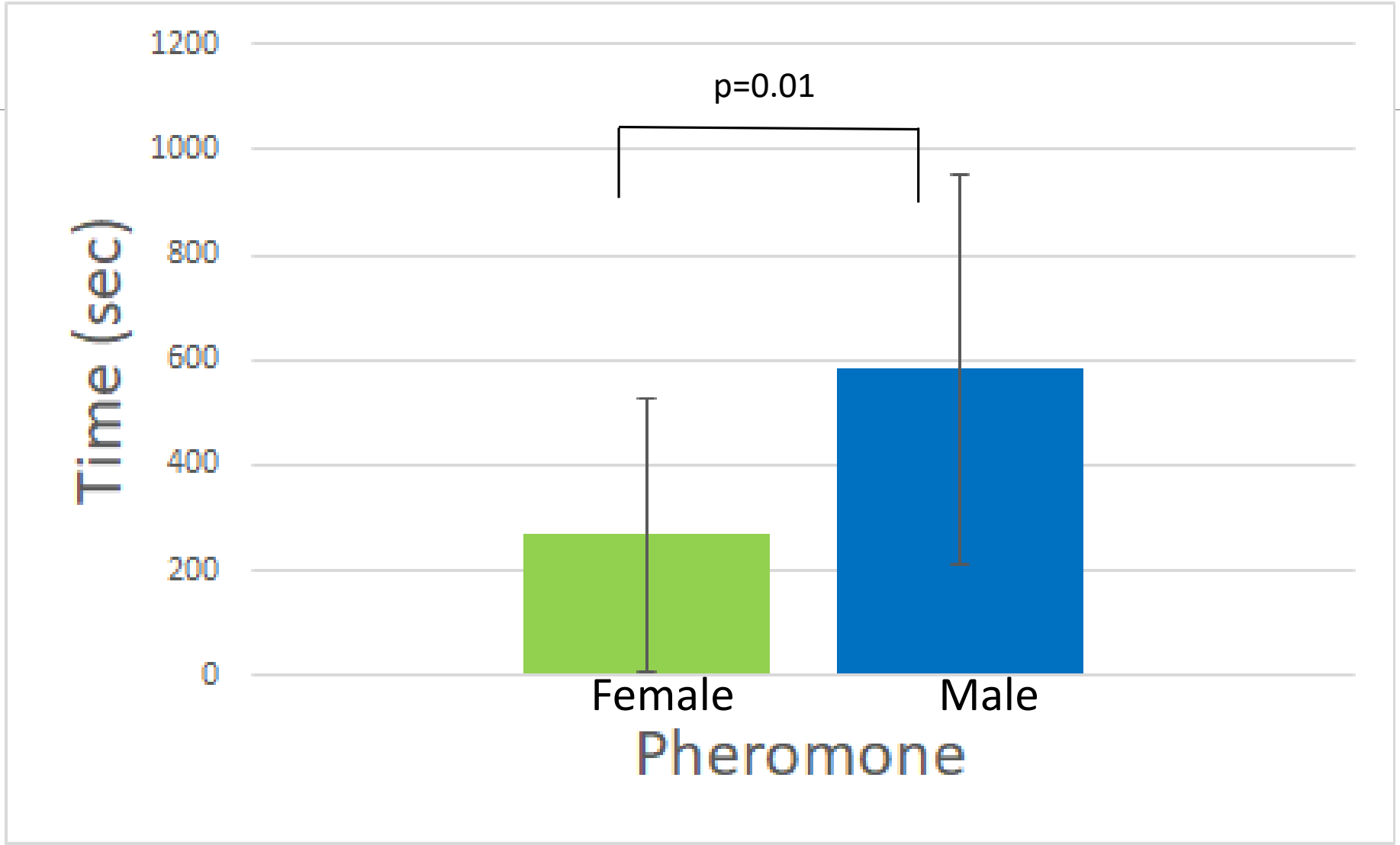
Analysis

Analysis

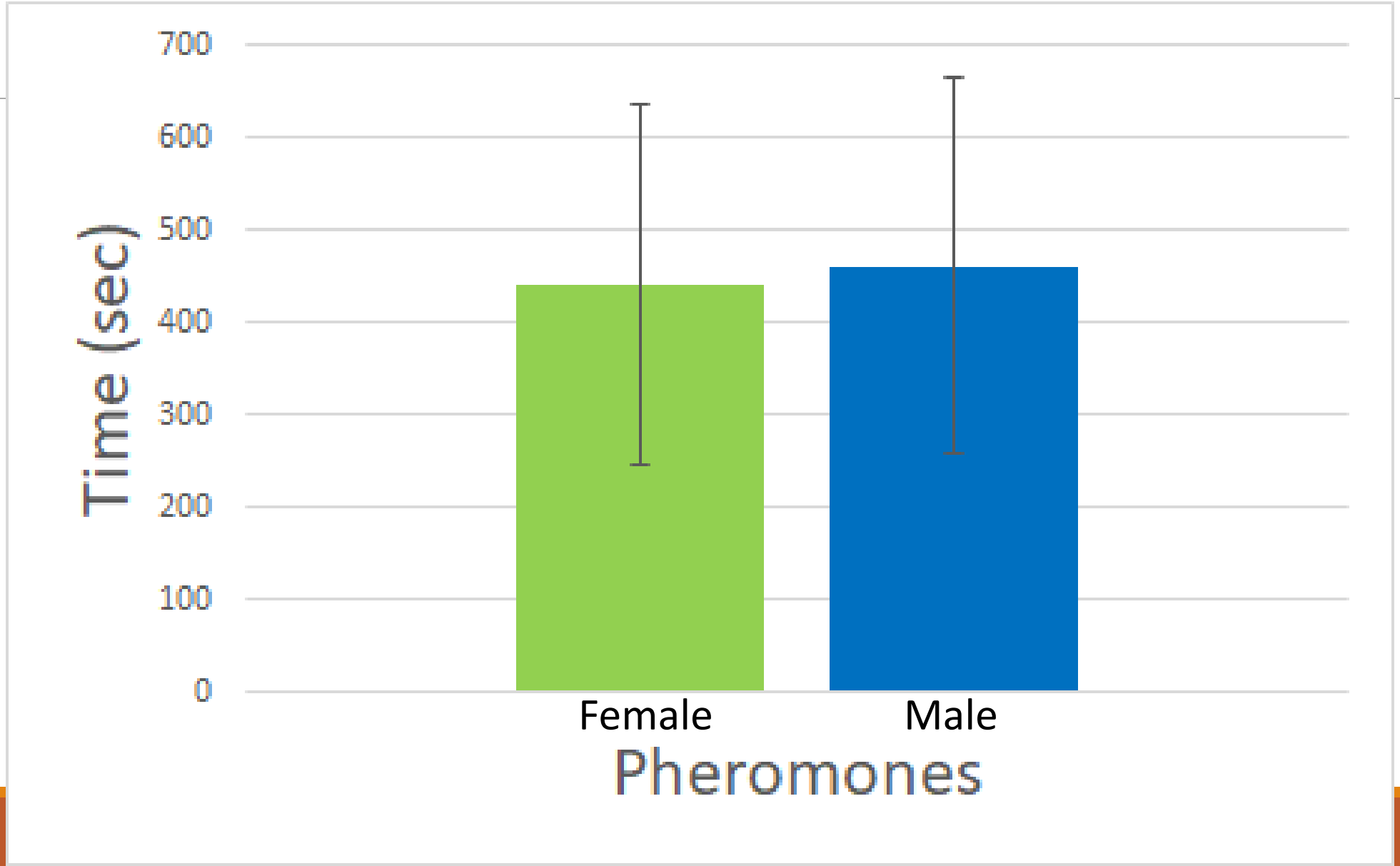
- **Variables measured**
  - Total time the spent in each compartment
  - Amount of times crayfish turned around in each arm

- **Statistical analysis**
  - Two-tailed t-test (within sexes)
  - Significance p-value <0.05

Females prefer male pheromones



Males show no preference



Conclusion

- Male rusty crayfish show no preference
- **Female rusty crayfish are attracted to male pheromones**
  - **Possibility for baited traps?**

Future studies

- Increase sample size
- Determining the structure of the molecule

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Questions???

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